

Stress, Eating, and Weight Change: The Moderating Role of Self-compassion

A thesis submitted in partial fulfilment of the requirements for the degree of Master of
Science in Psychology.

By Katie Sullivan

Department of Psychology

University of Canterbury

2018

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Acknowledgements

Firstly, I would like to thank my primary supervisor Roeline Kuijer, without whom this thesis would not have been possible. Thank you for your patience, expert guidance, and especially for your understanding when life's curveballs interrupted my studies. Thank you for introducing me to a topic I have since developed a keen interest in. I would also like to thank my associate supervisor Jessica Kerr for her helpful comments at the proposal stage and, of course, for her involvement in the initial data collection.

Thank you to my partner Miro who provided support, laughs, and was there for me during the ups and downs of the past year. Thanks also to my parents for their endless encouragement and support, and for always believing in me.

And last but not least, thanks to my friends who provided support in the form of coffee dates, walks, wines, and much needed distraction. Thank you for taking an interest in my topic, and for being willing to listen to both my complaining and my excitement about my thesis.

Abstract

Rising obesity rates are putting strain on public health systems worldwide. It is therefore important to identify and target high risk periods for weight gain. One such period is the first year of university, where students often gain weight at a significantly higher rate than non-students of the same age. Stress is commonly experienced by students and has been associated with both weight gain and weight loss in the literature, as well as an unhealthy change in eating behaviours. This thesis used a longitudinal design to examine stress as a risk factor for weight change and eating behaviour change in students during their first year of university and at follow-up two years later. The role of self-compassion was investigated as a potential moderator in this relationship. Results showed that students on average gained 1.61kg across their first year, and an additional 2.58kg from the end of their first year to the end of their third year. Stress was not directly associated with changes in body mass index (BMI), nor with changes in eating behaviour. As predicted, self-compassion significantly moderated the relationship between stress and BMI change: those with low self-compassion and high average stress during their first year gained weight. This moderation effect was not observed for follow-up BMI change, and was not observed for stress and eating behaviour change. These results suggest self-compassion moderates the stress-BMI change relationship *while* stress is being experienced, thus interventions aimed at reducing weight gain and stress should involve concurrent self-compassion training. Future research should employ experimental designs and self-compassion interventions to further investigate relationships between stress, self-compassion, BMI change, and eating behaviour.

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Stress, Eating, and Weight Change: The Moderating Role of Self-compassion

Overview

Rates of overweight and obesity have been growing rapidly, putting strain on public health systems around the world due to their associated negative health and economic consequences (Wyatt, Winters, & Dubbert, 2006). Once weight has reached the point of obesity it can be difficult to return to, and remain at, a normal weight (Elfhag & Rössner, 2005). It is therefore important to identify risk periods for weight gain in order to develop targeted interventions aimed at the prevention of obesity. The current study will examine a critical risk period for weight gain – the first year of university. The role of stress with regards to both weight change and change in eating behaviours will be addressed. Stress has been extensively researched as a risk factor for both weight gain and weight loss, and has also been found to influence eating behaviours (Torres & Nowson, 2007; Wardle, Chida, Gibson, Whitaker, & Steptoe, 2011). However, the relation between stress, eating behaviour, and weight change is complex suggesting that moderator variables may play a role. The current study examines the role of self-compassion as a potential moderator in the relation between stress, eating behaviour, and weight change in university students.

Obesity and Weight Gain

Obesity prevalence and health outcomes

Obesity is a growing global epidemic in both developed and developing countries. According to the World Health Organization (2016), the worldwide prevalence of obesity more than doubled between 1980 and 2014, with 1.9 billion adults over 18 overweight (39% of the world's population), and 600 million obese (13%). In New Zealand, obesity rates are also increasing. The most recent Ministry of Health statistics show that in 2017 32.2% of New

Zealanders were classified as obese (compared to 26.5% in 2006/07). A further 34.4% of adults were overweight but not obese. Extreme obesity (a BMI of more than 40) was also on the rise at 5.5% in 2017, compared to 3.4% in 2007 (Ministry of Health, 2017). Body mass index (BMI) is calculated by dividing a person's weight, in kilograms, by their height, in meters squared. People are classified as obese when their BMI exceeds 30. A BMI between 25 and 30 is considered overweight, between 18.5 and 25 is considered normal, and below 18.5 is considered underweight (World Health Organization, 2016).

Obesity has been linked to a range of non-communicable diseases and causes of mortality (e.g., diabetes, heart disease, cancer). A meta-analysis of 139 studies ($n = 3,951,455$ participants across Asia, Australia and New Zealand, Europe and North America) found that both overweight ($BMI > 25$) and obesity ($BMI > 30$) were associated with significantly higher hazard ratios for all-cause mortality. Participant inclusion was restricted to those who had never smoked, and those without existing chronic illness, as both are known to affect both BMI and mortality (Global BMI Mortality Collaboration, 2016). Another meta-analysis (57 studies, $n = 894,576$) found that mortality was lowest in the 22.5 – 25 BMI range. As BMI increased, so did mortality. For each 5kg/m^2 increase in BMI, all-cause mortality increased by 30% (Prospective Studies Collaboration, 2009). These preventable non-communicable diseases incur a great burden on countries' public health systems. In 2006 the cost of overweight and obesity for the New Zealand health care system was estimated to be \$624m (4.4% of total health expenditure), and the cost of lost productivity due to overweight and obesity health concerns was estimated to be between \$98m and \$225m (Lal, Moodie, Ashton, Siahpush, & Swinburn, 2012). With the rising rates of obesity in New Zealand over the past 10 years, estimates of public health costs today are likely to be greater.

Once weight gain has increased to the point of obesity, it is notoriously hard to return to, and remain at, a normal weight (Elfhag & Rössner, 2005). Prevention of initial weight gain, during periods where there is a high risk of weight gain, is a key component in the battle against the rising rates of obesity (Quick et al., 2014). Developing and maintaining good health behaviours such as eating a healthy diet rich in fruit and vegetables and getting the recommended amount of physical activity is important to ensure weight gain does not reach levels of overweight or obese (World Health Organization, 2006). According to Ministry of Health official 2017 statistics, only 38% of adults eat the recommended three servings of vegetables and two servings of fruit per day (a significant decrease from 43% in 2006/07). Only half of New Zealanders (50.2%) rated themselves as meeting minimum standards for physical activity (defined as 2.5 hours of activity over the course of a week) (Ministry of Health, 2017).

High risk periods for weight gain: The first year at university

Young adulthood (ages 18-34) has been identified as a critical risk period for weight gain, where the development of long term health related behaviours can contribute to the risk of obesity (Laska, Pelletier, Larson, & Story, 2012; Nelson, Story, Larson, Neumark-Sztainer, & Lytle, 2008). Developing positive health behaviours during this time is important to help prevent gradual onset of weight gain throughout the 20s and 30s. The first year of university (often referred to as the Freshman year in the US literature) is one such critical period. The Freshman 15 is a phenomenon made popular by the media, where first year university students are said to gain around 15 pounds (6.8kgs) over the course of the academic year. Although the extent of weight gain is largely a myth, research has found that first year students are indeed susceptible to weight gain, and tend to gain weight at a significantly higher rate than their non-university peers (Levitsky, Halbmaier, & Mrdjenovic, 2004). One study estimated this weight gain to be 6.7

times greater than that of a non-student adult (Kasperek, Corwin, Valois, Sargent, & Morris, 2008). A meta-analysis by Vella-Zarb and Elgar (2009) found an average weight gain of 1.75kg in first-year university students. A more recent study found similar results with students gaining an average of 1.55kg in their first year (Fedewa, Das, Evans, & Dishman, 2014). Another study showed weight gain continued to increase to around 4.38kgs by the end of the second year (Pope, Hansen, & Harvey, 2016). In a New Zealand sample, Boyce and Kuijer (2015) found students gained on average 1.10kg during their first year at university (with 55% of students gaining weight, and 31% losing weight). Thus, the average weight gain is much less than 6.8kgs and most studies show that not all students gain weight: some maintain their weight, and some lose weight.

While this shows the Freshman 15 phenomenon may not be accurate in terms of actual weight gained, it does emphasise the risk of weight gain across the university years, and the importance of developing healthy behaviours at this critical juncture to enable a healthy life trajectory. Even being mildly or moderately overweight at 20 – 22 years has been linked to significant risk of obesity by age 35 – 37 (McTigue, Garrett, & Popkin, 2002).

Why university students gain weight, and why they gain weight at a higher rate than those of the same age who do not attend university has many contributing factors. The university years often involve lifestyle factors that contribute to weight gain. Reductions in physical activity (Jung, Bray, & Ginis, 2008); changes in eating habits due to meal plans at university dormitories (Levitsky et al., 2004); increased intake in junk food and decreased intake in fruit and vegetables (Kasperek et al., 2008; Levitsky et al., 2004); reduced sleep duration and increased sleep problems (Quick et al., 2014); and increased alcohol consumption (Lloyd-Richardson, Lucero,

DiBello, Jacobson, & Wing, 2008) have all been associated with increases in weight in students, particularly in their first year of university.

The first year at university is often a time of increased stress for students. Coping with academic pressures, building a new social network, financial difficulties, and changes in living situation are all common sources of stress experienced by first year students (Dusselier, Dunn, Wang, Shelley Li, & Whalen, 2005). Stress affects a wide range of health behaviours and has implications for both weight gain and weight loss.

The Role of Stress

Stress and weight change

Stress can be defined as a series of behavioural, neuroendocrine and cognitive responses to a challenging or threatening event. Once a stressful event is detected, the body's acute response is to release hormones such as cortisol that result in vigilance, increased heart rate and blood pressure, redirection of blood to the muscles, and decreased libido (Adam & Epel, 2007). Activation of the stress system is designed to prompt the organism to adapt to changes in its environment, increasing chances for survival. However, an inappropriate or prolonged stress response may contribute to development of endocrine, autoimmune, metabolic, and psychiatric disorders, the severity of which depends on environmental, genetic, and developmental factors (Charmandari, Tsigos, & Chrousos, 2005). Continued activation of the hypothalamic-pituitary-adrenal (HPA) axis has been linked to a range of negative outcomes. Increased abdominal adiposity due to long term exposure to cortisol (Björntorp, 2001; Charmandari et al., 2005); changes in BMI due to changes in cortisol levels (C. Roberts, Troop, Connan, Treasure, & Campbell, 2007); and increased risk of obesity due to chronic inflammation (Hamer & Stamatakis, 2008) have all been associated with overactivation of the HPA axis.

Although stress may contribute to obesity risk via hormonal changes as outlined above, the relationship between stress and weight is not straight forward and research has shown that stress can lead to both weight gain (Harding et al., 2014) and weight loss (Kivimäki et al., 2006). For example, a meta-analysis (Nyberg et al., 2012) pooling data from 13 longitudinal European studies on the role of job strain found a U-shaped association between job strain and BMI: those with BMIs in the underweight and obese groups had a higher proportion of job strain than those in the normal weight group. Longitudinally, they found that changes in job strain and changes in BMI tended to co-occur, such that transitioning from no job strain at baseline, to job strain at follow up resulted in BMI change and that this BMI change could be either an increase or a decrease.

However, other studies have found no significant direct relationship between stress and weight change. A meta-analysis (Wardle et al., 2011) examining 14 different cohorts from longitudinal studies on the effects of stress on weight gain found 25% of studies reported weight gain, and 6% reported weight loss as a result of stress. But the majority of studies (69%) did not find any effect of stress on weight gain or loss. The authors concluded that there are likely to be multiple factors modifying the effect of stress on weight change, and that future research should investigate behavioural and psychobiological variables that mediate and moderate the effect of stress on weight.

In student populations, stress has also been implicated in both weight gain and weight loss. A 2007 study (Serlachius, Hamer, & Wardle) found stress was associated with a higher odds ratio for both weight gain and weight loss, and that associations were stronger among women. These associations remained after controlling for health behaviours (smoking, alcohol, exercise and sleep). This study was limited by its retrospective and cross-sectional design –

participants were simply asked if they had lost weight or gained weight since starting university, and by how much. Longitudinal studies that use baseline weight measurements can provide a more accurate picture of how much weight is lost or gained under chronic stress, and how long it takes for weight change to occur. Using a New Zealand sample, Boyce and Kuijer (2015) used a longitudinal design to follow university students throughout their first year. Overall, they found that students gained weight (1.10kg) during their first year. However, this was qualified by an interaction between stress and baseline BMI. They found that students with high baseline BMIs at the beginning of the university year, who were also experiencing high levels of stress, gained weight over the course of the year. However, those with low baseline BMIs and high levels of stress lost weight over their first year. A similar effect of baseline BMI affecting whether someone will gain or lose weight due to stress has also been found in working populations (Kivimäki et al., 2006).

Together, these studies show the complicated, and at times contradictory, relationship between stress and weight change; but they confirm weight change as a function of stress does often occur. There are different mechanisms through which stress can affect weight change. Two different pathways are explored below: stress and appetite, and stress and food choices.

Stress and eating behaviour

An important way in which stress can influence weight change is due to its effect on appetite and food choices. Stress can have a bidirectional effect on appetite by either causing an individual to increase (hyperphagia) or decrease (hypophagia) their food intake. Acute stress, where the “fight or flight” response is activated, is often accompanied by a decrease in appetite in the short-term. Exposure to chronic stress however, often prompts an individual to seek out and consume energy dense foods (Charmandari et al., 2005). Some studies have found an

association between stress and increased appetite. One study by Kandiah, Yake, Jones, and Meyer (2006) used an online self-report design to assess college aged women's stress levels, appetite and food preferences. They found that when stressed, 81% of students experienced a change in appetite, and of those, 63% experienced an increase in appetite.

Stress has also been linked to decreased food consumption. Stone and Brownell (1994) measured male and female participants' daily stress levels and subsequent food intake for a period of 84 days. They found an overall dose-dependent trend of stress on eating behaviours where an increase in stress resulted in a decrease in food intake. The frequency of eating less when stressed occurred more often at higher levels of stress than lower levels. The frequency of eating more when stressed remained the same at all levels of stress. Findings also indicated that 80% of the sample were consistent in their behaviour of either eating more or less when stressed. Of the 80% who were consistent stress eaters, they found the majority (72%) ate less when stressed and 28% ate more when stressed. This consistent behaviour suggests that individual difference variables may be affecting whether someone eats more or less when stressed. Oliver and Wardle (1999) found approximately the same number of people reported eating more (38%) when stressed as less (42%). They found those who were currently dieting were more likely to report eating more when stressed, and non-dieters were more likely to eat less when stressed.

In addition to increasing or decreasing appetite, stress has been found to influence a variety of specific unhealthy eating behaviours such as increased high fat and fast food consumption (Ng & Jeffery, 2003; Sinha & Jastreboff, 2013); increased night eating (Wichianson, Bughi, Unger, Spruijt-Metz, & Nguyen-Rodriguez, 2009); increased binge eating in a non-clinical population (Sulkowski, Dempsey, & Dempsey, 2011); and also influences the types of foods consumed. For example, during a laboratory stressor participants in the stress

condition ate more of a highly palatable, high caloric food choice (M&Ms), than the healthy choice (grapes) compared to control participants in the no-stress condition (Zellner et al., 2006). The same study also surveyed participants and found that of those who reported eating more when stressed, 73% report consuming foods they normally avoid i.e., “junk foods”. When asked why they ate more junk food when stressed, half the participants reported these foods made them feel better (e.g., relaxed, comforted). A naturalistic study using self-reported diary entries found that daily hassles were associated with increased high fat and sugar snacks, and a reduction in vegetable consumption (O'Connor, Jones, Conner, McMillan, & Ferguson, 2008). Kandiah et al. (2006) found that under normal conditions, 80% of students reported eating healthily, whereas when under stressful conditions, only 33% ate healthily.

The hypothalamic pituitary adrenal (HPA) axis is centrally involved in changes to eating behaviour (both increased and decreased appetite, and food choices) while under stress (Adam & Epel, 2007). Cortisol released by the activity of the HPA has been linked to increased appetite during stress, and increased intake of highly palatable snack foods. Those who have higher cortisol reactions while under stress experience increased appetite and increased consumption of highly palatable foods (Epel, Lapidus, McEwen, & Brownell, 2001; Newman, O'Connor, & Conner, 2007; Takeda et al., 2004). The neurobiology of stress significantly overlaps with that of addiction; stress may alter the brain reward pathways resulting in the seeking of highly palatable foods (Sinha & Jastreboff, 2013). Moreover, these highly palatable foods can in turn have a direct and indirect impact on the stress response of the HPA axis (Dallman et al., 2003) suggesting there may be a neurobiological basis for repeated stress eating. Adam and Epel (2007) propose that this addiction-like stress eating behaviour is mediated by increased levels of cortisol, which increases the drive to consume highly palatable foods mediated by increases in

insulin, neuropeptide Y, and leptin. They theorised that these mediators cause the addiction-like properties of stress eating by causing hedonic withdrawal, driving the individual to consume more highly palatable foods to relieve the negative state, even when the stressor is no longer present.

Moderators of the Stress, Eating Behaviour, and Weight Change Relationship

The studies discussed above show that stress, eating behaviour and weight change are intertwined, but more research is needed to understand the relationship between these variables. Stress has a complicated, bidirectional relationship with weight change and eating behaviour. It is related to both increases and decreases in weight, it is related to both increases and decreases in appetite, and it promotes the consumption of unhealthier foods (“junk foods” and highly palatable foods). This bidirectional relationship suggests that other contextual and individual difference variables moderate outcomes, and prompts the question of what factors contribute to stress-related eating patterns and weight change.

Moderators are variables that affect the strength and direction of a relationship between an independent and dependent variable. Adding a moderator into a model can be a valuable way of gaining more information about how, and under what conditions, an independent variable affects a dependent variable. Baseline BMI and dietary restraint are two examples of moderators that have been examined in the relationship between stress, weight change, and eating behaviour. For example, a number of studies have found that psychological stress is related to weight gain, but only in individuals with higher baseline BMI (and related to either weight loss or no weight change in individuals with lower baseline BMI). This has been found in adult samples (J. P. Block, He, Zaslavsky, Ding, & Ayanian, 2009; Kivimäki et al., 2006) as well as first-year university students (Boyce & Kuijer, 2015). Research examining the role of dietary restraint has

found that individuals with higher levels of dietary restraint are more likely to increase unhealthy food intake, as well as total caloric intake under stress (Wardle, Steptoe, Oliver, & Lipsey, 2000). Social support may also buffer the relationship between stress eating and BMI change especially among males (Darling, Fahrenkamp, Wilson, Karazsia, & Sato, 2017). However, other potential moderator variables that have received much less attention in the literature are personality or individual difference variables. The current study examines self-compassion as a potential moderator.

Self-compassion

Self-compassion is a concept stemming from Buddhist meditative practices. It involves directing compassion toward the self in instances of distress, perceived inadequacy, or failure. Over the past decade, self-compassion has steadily gained popularity as a construct in psychological and health research (Neff, Whittaker, & Karl, 2017).

Kristen Neff was the first to scientifically define the construct of self-compassion and develop scales to quantitatively measure it (Neff, 2003a, 2003b). According to Neff, self-compassion consists of three sliding-scale components: self-kindness versus self-judgement, mindfulness versus over-identification, and common humanity versus isolation. *Self-kindness* is the tendency to be kind and understanding towards oneself in times of stress and failure, as opposed to being harsh and critical. *Mindfulness* involves taking a mental step back to have a balanced awareness of one's present affect or physical state, without over-identifying with, or excessively dramatizing, any resulting negative emotions. *Common humanity* means recognising that struggles and personal shortcomings are a shared part of the human experience, and that all people lead imperfect lives, as opposed to believing oneself to be isolated in one's suffering. These three components combine to form a higher-order factor of self-compassion. Neff (2016)

examined the scale in five different populations and found over 90% of variance could be explained by one overall self-compassion factor.

The concept of self-compassion is related to self-esteem, and has been found to correlate ($r = 0.59$) with measures of self-esteem (Neff, 2003a). However, there are several important differences between self-compassion and self-esteem. Self-compassion is based on feelings of self-care and non-judgemental awareness of suffering or personal shortcomings, whereas self-esteem is based on positive self-evaluations (Neff, Kirkpatrick, & Rude, 2007). A positive evaluation of personal characteristics or abilities is not required to behave compassionately towards the self. Moreover, self-compassion is not correlated with narcissism, whereas self-esteem is (Neff, 2003a). Self-esteem involves aspects of comparison to others, whereas self-compassion is independent of the judgement of others; it is not necessary to engage in social comparison to have a self-compassionate mindset (Neff, 2003a). Finally, self-compassion has been successfully induced in experimental settings and raised via clinical interventions (Leary, Tate, Adams, Allen, & Hancock, 2007; Neff & Germer, 2013). Self-esteem however, is difficult to raise experimentally, and is resistant to interventional change (Swann, 1996).

Self-compassion has been related to a wide range of positive psychological outcomes (Barnard & Curry, 2011). It is significantly negatively correlated with anxiety and depression measures, and positively correlated with measures of psychological well-being (Bluth et al., 2016; Neff, 2003a). In a student population, levels of self-compassion accounted for a significant amount of variance in overall well-being (Neely, Schallert, Mohammed, Roberts, & Chen, 2009). A meta-analysis of 20 samples from 14 studies (MacBeth & Gumley, 2012), found that higher levels of self-compassion were correlated with lower levels of psychopathology, with an effect size of $r = -0.54$.

Self-compassion and stress

In addition to positive effects on psychological outcomes, higher levels of trait self-compassion are related to lower levels of perceived stress (Finlay-Jones, Rees, & Kane, 2015; Homan & Sirois, 2017; Soysa & Wilcomb, 2015). Self-compassion has also been found to buffer some of the negative effects of stress. For example, Zhang, Luo, Che, and Duan (2016) found that among students with chronic stress (studying for a difficult graduate school entry test) those with higher levels of self-compassion experienced lower levels of stress compared to those lower in self-compassion. They also found that self-compassion buffered the relationship between stress and negative affect, whereby those higher in self-compassion experienced lower levels of negative affect while experiencing stress. Neff and colleagues (Neff et al., 2007) found that trait self-compassion helps to buffer against feelings of anxiety when presented with an ego-threat stressor in a laboratory setting. Self-compassion has also been found to moderate the relationship between stress and sleep. In a diary study, those who were higher on self-compassion took less time than those with low self-compassion to fall asleep after experiencing stressful events during the day (Hu, Wang, Sun, Arteta-Garcia, & Purol, 2018). In a sample of diabetes patients, self-compassion was found to moderate the relationship between distress and HbA1c (a blood marker associated with diabetes complications), where higher distress predicted higher levels of HbA1c, but only for participants low in self-compassion (Friis, Johnson, Cutfield, & Consedine, 2015).

Physiological markers of stress are also affected by levels of self-compassion. In response to a social stress test, Breines et al., (2015), found that young adults who scored higher in trait levels of self-compassion had lower saliva alpha-amylase (a sympathetic nervous system marker) during repeated social stress tests. The authors concluded that the buffering effect of self-compassion on nervous system activation during stress could protect against some of the

negative effects of stress on health outcomes. In a similar study, Brienese et al., (2014), measured interleukin-6, a stress induced inflammatory response of the nervous system that may have negative implications for physical health. They found participants with higher levels of self-compassion had significantly lower interleukin-6 levels in response to a laboratory induced social stress test. They concluded self-compassion may be a protective factor against stress induced inflammation. Using the same social stress test, Bluth et al. (2016) found that adolescents who were higher in self-compassion had a significantly smaller increase in systolic blood pressure during the stress test than those who were low in self-compassion.

In addition to the effect of individual differences in trait self-compassion on stress responses, inducing self-compassionate states in the laboratory and interventions aimed at increasing levels of self-compassion have also been found to affect both perceived stress levels and physiological markers of stress. For example, in a pilot study of a mindfulness and self-compassion intervention with teenagers, an increase in self-compassion post-intervention was significantly correlated with a decrease in perceived stress post-intervention (Bluth, Roberson, & Gaylord, 2015). Another study found that compared to controls, participants who underwent a brief intervention aimed at increasing levels of self-compassion had lower saliva alpha amylase responses after a social-stress test (Arch et al., 2014). These participants also experienced lower cardiac parasympathetic and perceived anxiety responses.

Self-compassion and health behaviours

In addition to the psychological and physiological benefits, self-compassion has been related to a range of positive health and eating behaviours. Research in a non-clinical population found those higher in trait self-compassion tend to report lower levels of disordered eating behaviours (Webb & Forman, 2013). Self-compassionate individuals report higher levels of

intrinsic motivation for exercise, and lower levels of external or body image motivations for exercise (Magnus, Kowalski, & McHugh, 2010). In a sample of college students, higher self-compassion was related to more mindful eating, lower eating disorder symptomology, and lower BMI (Taylor, Daiss, & Krietsch, 2015). In another study, those higher in self-compassion showed more intuitive eating behaviours with lower dietary restraint, eating for physical hunger rather than for emotional reasons, and a greater reliance on internal satiety cues to determine when to stop eating (Schoenefeld & Webb, 2013). Self-compassion is also related to increased self-regulation, particularly regarding intentions to engage in health promoting behaviours (Terry & Leary, 2011).

In a meta-analysis by Sirois, Kitner, and Hirsch (2015), fifteen independent samples were analysed that measured the relationship between self-compassion and the pooled scores of four different health behaviours: healthy diet, exercise, sleep, and stress management. Self-compassion was positively correlated with healthy behaviours, although the effect sizes were small (average $r = .25$, $p < .001$). In another study by Sirois (2015), a self-regulation resource model was proposed whereby self-compassion increases self-regulation resources, leading to intentions to engage in health behaviours. They showed that participants higher in self-compassion had stronger intentions to engage in health behaviours, and this relationship was mediated by self-compassionate individuals' increased self-regulation resources (higher levels of self-efficacy surrounding health behaviours coupled with lower levels of negative affect). Mindfulness, a core component of the self-compassion construct, is associated with health behaviours (Gilbert & Waltz, 2010), and with the relationship between stress and health behaviours such as sleep quality, binge eating, physical activity, and overall physical health (K. C. Roberts & Danoff-Burg, 2010).

Homan and Sirois (2017) proposed that self-compassion is linked to overall physical health due to stress-reduction and increased engagement in health promoting behaviours. They found that people higher in self-compassion had lower levels of stress and engaged in higher levels of health behaviours such as healthy eating, physical activity, and seeking medical care, which in turn was related to better physical health. These findings provide strong support for the positive effect of self-compassion on both stress and health outcomes. However, this study was correlational, and so experimental or longitudinal studies are needed to further investigate these findings.

The Current Study

Research on self-compassion has been growing at an exponential rate, examining the positive effects of self-compassion on a wide range of psychological and health outcomes. Self-compassion has been found to correlate with higher engagement in health behaviours (including healthy eating behaviour), and with lower BMI (Sirois et al., 2015; Taylor et al., 2015). A number of recent studies point to the potential moderating role of self-compassion in the relationship between stress and a variety of outcomes (e.g., negative affect, sleep, diabetes outcomes: see Zhang et al., 2016; Hu et al., 2018; Friis et al., 2015), suggesting that self-compassion may buffer the negative effects of stress.

Given the complex relationship between stress, eating behaviour and weight change, researchers have begun to look at variables that moderate the effects of stress on BMI and eating behaviours (J. P. Block et al., 2009; Boyce & Kuijer, 2015; Wardle et al., 2000). The aim of the current study was to extend this research by examining the potential moderating role of self-compassion, a variable that has not been studied before as a moderator in the relationship between stress and eating behaviour/weight change. Using a longitudinal design, a sample of

first-year students was assessed multiple times during their first year at university (measuring stress, eating behaviour, BMI, and self-compassion) and then once more at the end of their third year of university (BMI only).

Based on previous research I expect to find:

1. The average student to gain weight during their first year at university (see Boyce & Kuijer, 2015; Vella-Zarb & Elgar, 2009). I also expect their weight to have increased further by the end of their third year (Pope et al., 2016).
2. The average student to decrease their healthy eating behavior (fruit and vegetable intake) and increase their unhealthy eating behavior (fats and snacks intake) over their first year at university (Kasperek et al., 2008; Levitsky et al., 2004).
3. Perceived stress over the first year at university to be positively related to weight gain and unhealthy eating behavior (less fruit and vegetable intake, more fats and snacks intake) (Kandiah et al., 2006; O'connor et al., 2008), although it should be mentioned here that previous research on the link between stress, eating behavior, and weight change is not consistent (showing that stress can lead to both weight gain and weight loss and to increased and decreased food intake) (Oliver & Wardle, 1999; Serlachius et al., 2007).
4. Low levels of baseline self-compassion to be related to unhealthier eating behavior (lower fruit and vegetable intake, higher fats and snacks intake), and higher BMI, both at baseline and at the end of the first year (Homan & Sirois, 2017; Rahimi-Ardabili, Reynolds, Vartanian, McLeod, & Zwar, 2017; Taylor et al., 2015). Higher levels of baseline self-compassion to be related to lower levels of perceived stress over the course

of the first year at university (Finlay-Jones et al., 2015; Homan & Sirois, 2017; Soysa & Wilcomb, 2015).

5. Self-compassion to moderate the relationship between stress and weight change, and stress and eating behaviour in such a way that students who scored low on self-compassion at baseline would gain weight and report unhealthier eating behaviour when experiencing high levels of stress during their first year at university (while controlling for potential covariates such as other health behaviours, physical activity or alcohol intake, and demographic variables - age, sex, living situation). I expect students who scored high on self-compassion to be buffered from these negative effects of stress on weight and eating behaviour. With regard to weight change, I expect to find this both at the end of the first year and the end of the third year at university.

Method

Participants and Procedure

Participants were first-year students enrolled at the University of Canterbury who completed online questionnaires (via Qualtrics) 4 times over the course of their first year at university (equally spaced between February – November, 2015). They were re-contacted two years later (by the author of this thesis) to complete a follow-up questionnaire at the end of their third year at university (Time 5: November 2017). Prize draws for gift vouchers and an iPad mini were used to encourage participants to stay in the study (Time 1-4). At Time 5 participants received a \$10 voucher for their time. The study was approved by the University Human Ethics Committee (see Appendix A and B).

Participants were recruited during the first two weeks of their first semester at university (via emails to large 100-level courses, and postings on 100-level course websites). A total of 362 people accessed the link to the first questionnaire. Of those, 77 did not start the questionnaire and 42 answered less than 50% of the questions. Three people completed the questionnaire twice (second attempt was deleted) and 7 people were not first-year students. This left 236 participants at Time 1. Of these, 143 (60% retention rate) completed Time 4, and 91 completed Time 5 (38% retention rate). The sample for the main analyses in this thesis therefore consisted of 143 first-year students. Follow-up analyses were done with the smaller sample ($n = 91$).

Participants who dropped out between Time 1 and Time 4 did not differ significantly on any of the demographic measures or study variables except for BMI and sex. Participants who dropped out between Time 1 and Time 4 had significantly higher baseline BMI ($M = 24.09$) than those who completed the study ($M = 22.81$), $t(231) = 2.33$, $p < .05$. A higher proportion of males (57%) than females (38%) dropped out between Time 1 and Time 4, $\chi^2(1, 234) = 7.76$, $p < .01$.

.01. Participants who dropped out between Time 4 and Time 5 did not differ on any of the study variables except for perceived stress assessed during their first year at university. Participants who did not complete the Time 5 follow-up had significantly higher average stress levels across Time 1 and Time 4 ($M = 47.68$) than those who completed Time 5 ($M = 43.90$), $t(139) = -2.81$, $p < .01$.

The demographic characteristics of participants completing the Time 1 – Time 4 questionnaires ($n = 143$) and the Time 5 questionnaire ($n = 91$) are presented in Table 1. As can be seen, participants were predominantly female and of New Zealand European descent. At Time 1 the majority either lived with their parents or in a hall of residence. At Time 5 the majority were flatting.

Table 1
Sample Demographics

		Main sample (<i>N</i> = 143)		Follow-up sample (<i>N</i> = 91)	
Age at T1		19	(3.71)	19	(3.77)
Age at T5				21.6	(3.74)
Sex					
	Female	110	(76.9%)	74	(81.3%)
	Male	32	(22.4%)	17	(18.7%)
Ethnicity					
	NZ European	109	(76.2%)	76	(83.5%)
	Maori	8	(5.6%)	4	(4.4%)
	Chinese	14	(9.8%)	9	(9.9%)
	Other	12	(8.4%)	2	(2.2%)
Living situation at T1					
	At home with parents	58	(40.6%)	33	(36.3%)
	Halls of residence	51	(35.7%)	37	(40.7%)
	Flatting	24	(16.8%)	15	(16.5%)
	Other	10	(7.0%)	6	(6.6%)
Living situation at T5					
	At home with parents			18	(19.8%)
	Halls of residence			4	(4.4%)
	Flatting			61	(67.0%)
	Other			8	(8.8%)

Note: Mean (*SD*) or number of cases (%) are presented.

Measures

In this section, only the measures used in the current thesis are described.

Demographics. Data were collected on participants' sex and ethnicity at Time 1. Data on age and living situation (e.g., flatting, hall of residence) were collected at Time 1 and Time 5.

Self-Compassion (Time 1). The Self-Compassion Short-Form Scale (Raes, Pommier, Neff, & Van Gucht, 2011) was used to measure trait self-compassion. This 12 item scale is

shortened version of the 26 item Self-Compassion Scale (Neff, 2003a). Items are rated on a scale ranging from 1 (*almost never*) to 5 (*almost always*). Items include: “When I fail at something important to me I become consumed by feelings of inadequacy”, “I try to be understanding and patient towards those aspects of my personality I don’t like”, and “When I feel inadequate in some way, I try and remind myself that feelings of inadequacy are shared by most people” (for the full scale see Appendix H). Negatively worded items are reverse scored, and scores are summed to produce an overall self-compassion score. Higher scores indicate higher levels of self-compassion. The short-form scale was found to have a near perfect correlation ($r = 0.97$) with the full Self-Compassion scale (Raes et al., 2011). Cronbach’s alpha for the Self-Compassion Short-Form Scale in the current study was .80.

Perceived Stress (Time 1, 2, 3, 4). Perceived stress was measured with 16 items: the 10 item Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983) supplemented with 6 items from the College Student Stress Scale (Feldt, 2008). The Perceived Stress Scale contains items related to general perceived stress, without reference to specific life events. In this scale participants are asked to rate how often they felt a certain way in the last month ranging from 1 (*never*) to 5 (*very often*). Examples include: “How often have you felt nervous or ‘stressed’?”, “How often have you felt that you were unable to control the important things in your life?”, and “How often have you found that you could not cope with all the things you had to do?” Positively worded items are reverse scored so that higher scores on the summed scale indicate higher levels of life stress. The Perceived Stress Scale has shown good internal consistency in previous research (Cohen et al., 1983). The Perceived Stress Scale was supplemented with 6 items from the College Student Stress scale (Feldt, 2008) to assess stress specifically related to university life. Participants were asked to rate how often they felt stressed due to specific

university-life-related situations in the past month on a Likert scale of 1 (*never*) to 5 (*very often*). Examples include: “Felt anxious or distressed about personal relationships”, Felt anxious or distressed about academic matters”, and “Felt anxious or distressed about financial matters”. Scores are summed to produce an overall student stress score in which higher scores indicate higher levels of student related stress.

The Perceived Stress scale and College Student Stress scale were combined to form one comprehensive scale of both university related stressors and general life stressors. Chronbach’s alpha for the combined scale was good, ranging from .83 to .88 over the four time points. Stress levels at Times 1, 2, 3 and 4 were summed and then averaged to produce an overall stress score for the year. Stress levels at the four time points across the year correlated highly, with correlations ranging from $r = .42, p = < .01$, to $r = .62, p < .01$.

Body Mass Index (BMI) (Time 1, 4, 5). Self-reported height (Time 1) and weight (Time 1, 4 and 5) were used to calculate BMI (kg/m^2).

Eating behaviour (Time 1, 4). Eating behaviour was measured with the Fat and Fibre Screener (G. Block, Gillespie, Rosenbaum, & Jenson, 2000). This scale is a brief version of the validated Block 100 item Food Frequency Questionnaire, and measures the frequency of consumption of meats, fat, junk food snacks, condiments, fruits, vegetables and grains during the past month (see Appendix H for a full list of foods). The 5-point scale ranges from once a month or less, to 5 or more times a week. The scale is divided into two subscales: Meats and Fats (17 items), and Fruits and Vegetables (10 items). Scores are summed to produce an overall intake score for each of the two subscales. Higher scores indicate higher intake of each group of foods. The Fat and Fibre screener correlates well with the full length validated 100 item Block Food screener (G. Block et al., 2000).

Alcohol intake (Time 1, 4). Intake was measured with one item: “How many standard drinks do you currently consume in a typical week?” An image describing typical standard drinks in a glass of wine, a bottle of beer, and a shot of spirits was depicted below the question to assist participants in accurately estimating their alcohol intake.

Physical activity (Time 1, 4). The International Physical Activity Questionnaire (IPAQ) (Craig et al., 2003) was used to assess levels of physical activity. Items are based on the last 7 days. Participants are asked on how many days (0-7 days) a particular activity was performed, and for how many hours/minutes each day. Items include: “During the last 7 days on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics or fast bicycling”, and “During the last 7 days, on how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking”. Minutes spent performing each type of activity are summed and then multiplied by how many days per week the activity was performed. A formula is then applied to calculate a weekly Metabolic Equivalent of Task (MET) score. Higher MET scores indicate higher levels of physical activity. According to IPAQ guidelines, scores can be analysed as categorical data (low, medium, and high levels of physical activity), or as continuous data. Due to the rest of the measures being continuous, IPAQ data was scored and treated as a continuous variable. However, in the current study only 58% of the sample completed the minutes per day question for each type of activity, so minutes per day were excluded and only days per week were used for each type of exercise, and then converted to MET scores according to IPAQ guidelines.

Analyses

Analyses were conducted using SPSS version 23. Simple slopes analyses for interaction effects were conducted using the PROCESS macro for SPSS (Hayes, 2018). Significance level was set at $p < .05$ for all analyses. All significance tests were conducted as two-tailed tests. Data was cleaned prior to beginning analysis. Plots were then examined for outliers. One case was removed due to the participant selecting option 5 on every Likert scale regardless of whether the question was positively or negatively worded, suggesting that they completed the questionnaire carelessly. Distributions were examined for skewness and kurtosis.

Subscales were calculated for multi-item scales. A minimum of 75% completion of the scale was required for a case to be included in the analysis. Means and standard deviations for each multi-item measure were then calculated. Cronbach's alphas were calculated for each scale to determine reliability. Change scores were calculated for BMI ($T4 - T1$; $T5 - T4$; $T5 - T1$); meats, fat, and snacks ($T4 - T1$); fruit and vegetable intake ($T4 - T1$); alcohol intake ($T4 - T1$); and physical activity ($T4 - T1$). Correlation matrices for demographic measures and study variables were created to determine relationships between variables, to assess potential multicollinearity issues, and to identify covariates that needed to be accounted for in regression analyses. T-tests were performed to examine changes from Time 1 to Time 4 in BMI, eating behaviour, physical activity and alcohol intake; and from Time 4 to Time 5, and Time 1 to Time 5 for changes in BMI.

Hierarchical multiple regression analyses were used to investigate whether self-compassion moderated the relationship between stress and change scores in BMI, and stress and change scores eating behaviour (fruit and vegetable intake, and meats, fat, and snack intake) between Time 1 and Time 4. To avoid multicollinearity, stress and self-compassion were centred

prior to creating the interaction term. The Time 1 dependent variable (i.e., Time 1 BMI, fruit and vegetable intake, or meat, fat, and snack intake) was entered in Step 1, followed by any covariates in Step 2 (demographic variables, alcohol intake or physical activity if significantly correlated with change in the dependent variable). Self-compassion and stress were entered in Step 3, and the interaction term (stress x self-compassion) in Step 4. The analysis was repeated to examine whether self-compassion moderated the relationship between stress and changes in BMI between Time 4 and Time 5, and between Time 1 and Time 5.

Significant moderation effects were followed up with simple slopes analyses using the PROCESS macro to examine the slope and direction of the moderation effect at one standard deviation above the mean of the moderator, at the mean, and at one standard deviation below the mean. T-tests were performed to determine whether the slopes differed significantly from zero. Slope data was plotted on a graph to visually display the effects of the independent variable on the dependent variable at all three levels of the moderator.

Results

Changes Across the First Year at University (Time 1 – Time 4)

Descriptive analyses

Correlations and descriptive statistics for all variables are presented in Table 2. As predicted, those with lower levels of self-compassion had higher BMIs at Time 1 and Time 4 and, in line with previous research, reported higher levels of stress across their first year at university. Contrary to predictions, no significant correlations were found between self-compassion and eating behaviours, nor with physical activity level or alcohol intake. Interestingly, sex was not correlated with self-compassion. This is in contrast to other studies that have found that females tend to report slightly lower overall self-compassion scores than males (Neff, 2003a; Yarnell et al., 2015).

Students with higher BMIs (Time 1 and Time 4) reported higher levels of stress across their first year at university. However, contrary to hypotheses, stress was not associated with a change in BMI across the year, nor with eating behaviors, but had a small positive correlation with alcohol use at Time 1 (but not at Time 4). BMI (at both time points, and the BMI change variable) was unrelated to eating behaviours, physical activity level or alcohol intake. Physical activity at both Time 1 and Time 4 was positively correlated with fruit and vegetable intake at both time points. Physical activity at Time 1 had a small negative correlation with the change score in fruit and vegetable intake. Living situation was correlated with meats, fat, and snack intake at both Time 1 and Time 4 (but not the change score) and fruit and vegetable intake at Time 4: those living away from home (flatting, halls of residence, other) ate more meats, fat and snacks at both time points and less fruit and vegetables at Time 4 compared to those living at home.

Table 2.

Correlation matrix: all variables Time 1 and Time 4

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1 Sex	1																			
2 Age (Time 1)	-.06	1																		
3 Living Situation	-.04	.20*	1																	
4 Self-Compassion	-.13	.03	-.06	1																
5 BMI t1	.05	.11	.03	-.24**	1															
6 BMI t4	.07	.10	.05	-.26**	.95**	1														
7 BMI change score	.07	-.02	.03	-.12	-.11	.22**	1													
8 Stress	.08	-.16	-.08	-.58**	.17*	.20*	.12	1												
9 Meats, Fat, and Snacks t1	-.11	.02	.21*	-.16	.04	.03	-.01	.07	1											
10 Meats, Fat, and Snacks t4	-.13	.04	.23**	-.08	-.06	-.05	.06	-.05	.64**	1										
11 Meats, Fat, and Snacks change score	-.06	.03	.06	.06	-.12	-.09	.08	-.13	-.23**	.60**	1									
12 Fruit and Vegetables t1	.01	-.15	.03	.07	-.10	-.13	-.10	-.02	.13	.13	.03	1								
13 Fruit and Vegetables t4	.10	-.06	.18*	.04	-.09	-.10	-.05	.02	.02	.10	.07	.55**	1							
14 Fruit and Vegetables change score	.10	.10	.14	-.04	.02	.03	.04	.05	-.12	-.07	.04	-.55**	.39**	1						
15 IPAQ t1	-.06	.00	-.09	-.02	.07	.04	-.07	.02	-.01	-.01	.00	.38**	.30**	-.18*	1					
16 IPAQ t4	-.05	-.07	.01	.01	.10	.10	-.02	.04	-.08	.03	-.08	.27**	.26**	-.06	.35**	1				
17 IPAQ change score	.09	-.06	.09	.03	.03	.05	0.05	.02	-.08	.04	-.07	-.09	-.03	.10	-.57**	.57**	1			
18 Alcohol t1	-.05	-.12	.06	-.13	.01	.06	.16	.17*	.14	.19*	.09	.17*	.02	-.20*	.15	.07	-.07	1		
19 Alcohol t4	-.13	-.03	.12	.01	.04	.05	.04	.09	.08	.07	-.01	.17*	.00	-.20*	.05	.04	-.01	.65**	1	
20 Alcohol change score	-.11	.09	.08	.16	.03	-.01	-.13	-.06	-.05	-.13	-.11	.02	-.03	-.04	-.11	-.03	.07	-.27**	.56**	1
<i>M</i>	1.78	19.03		34.56	22.82	23.34	.55	45.24	39.95	39.22	-.58	28.48	26.23	-2.17	60.10	57.97	-2.13	3.97	4.36	0.42
<i>SD</i>	0.42	3.74		7.03	4.12	4.21	1.38	7.83	7.13	8.79	6.87	6.50	6.03	5.91	20.21	20.32	23.07	6.23	7.19	5.69

Note. Sex: 1 = male; 2 = female. Living situation: 1 = Living at home with parents; 2 = living away from home (flatting, halls of residence, other)

* $p < .05$.

** $p < .01$.

Changes in weight, BMI, and health behaviours

Weight change frequencies indicated that 62.7% of students gained weight from Time 1 to Time 4, 21.1% lost weight, and 16.2% did not experience a change in weight from Time 1 to Time 4 (defined as either zero change or less than 1kg of weight gain or loss). This indicates that 83.8% experienced a change in weight during their first year at university. Consistent with predictions, students on average gained 1.61kg during their first year at university (SD = 3.95, range = -10kg to 21kg). Overall the average increase in weight between Time 1 (M = 65.25, SD = 13.55) and Time 4 (M = 66.86, SD = 14.08) was significant, $t(141) = 4.87, p < .01$. Paired samples t-tests indicated that average BMI increased significantly from 22.8 at Time 1 to 23.3 at Time 4, $t(141) = 4.73, p < .001$. Frequencies for BMI categories of underweight (BMI < 18.5 kg/m²), normal (BMI 18.5 – 25 kg/m²), overweight (BMI 25 – 30 kg/m²) and obese (BMI > 30kg/m²) also changed from Time 1 to Time 4. At Time 1, 11.9% were underweight, 65% normal weight, 18.2% overweight, and 4.9% obese. By Time 4 the percentage of normal and underweight BMIs had decreased while the percentage of overweight and obese BMIs had risen: 9.1% were now underweight, 60.8% normal, 23.8% overweight and 6.3% obese. A change in BMI over time was unrelated to demographic variables or (changes in) eating behaviour, physical activity levels or alcohol intake (see Table 2).

In line with hypotheses, fruit and vegetable intake decreased significantly between Time 1 and Time 4, $t(139) = 4.39, p < .001$, however meats, fat, and snack intake did not change significantly, $t(139) = 1.00, ns$. Physical activity levels, $t(142) = 1.11, ns$, and alcohol intake, $t(141) = 0.87, ns$, did not change significantly over time. Students who consumed more alcohol at both time points were more likely to report that they had decreased their fruit and vegetable intake (see Table 2). Fruit and vegetable intake correlated positively with physical activity at

both Time 1 and Time 4, and a change in fruit and vegetable intake was negatively correlated with physical activity at Time 1.

The moderating role of self-compassion

BMI change. In order to examine whether stress and self-compassion interacted to predict BMI change during the first year of university (Time 1 – Time 4), a moderation analysis was conducted. As none of the health behaviour variables (meats, fat, and snack intake; fruit and vegetable intake; physical activity; alcohol intake) or demographic variables were significantly correlated with BMI change, none were entered into the model as covariates. The results are displayed in Table 3.

The main effect of stress and self-compassion on BMI change controlling for Time 1 BMI was not significant. When the interaction term between stress and self-compassion was added into the model, the result was significant ($p = .02$). This indicates that there is a moderating effect of self-compassion and stress on BMI.

Table 3.*Interaction of stress and self-compassion on BMI change, meats and fats change, and fruit and vegetable change*

		R ² Δ	Step 1			Step 2			Step 3			Step 4		
			β	b	SE	β	b	SE	β	b	SE	β	b	SE
<i>BMI change</i>														
1	BMI T1	.008	-.090	-.028	.027	-.126	-.039	.027	-.158	-.049	.027			
2	Stress	.025				.088	.015	.018	.107	.018	.018			
	Self-Compassion					-.095	-.018	.020	-.108	-.020	.019			
3	Stress x Self-Compassion	.038*							-.199*	-.005	.002			
<i>Meats, Fat and Snacks intake change</i>														
1	Meats/Fats/Snacks T1	.052**	-.228**	-.217	.080	-.228**	-.217	.217	-.234**	-.222	.080			
2	Stress	.014				-.143	-.125	.090	-.139	-.120	.089			
	Self-Compassion					-.061	-.060	.102	-.055	-.054	.101			
3	Stress x Self-Compassion	.025 (p=.059)							.159	.018	.009			
<i>Fruit and Vegetable intake change</i>														
1	Fruit and Vegetable T1	.298***	-.546***	-.497	.066	-.545***	-.496	.073	-.544***	-.495	.074	-.542***	-.494	.074
2	Alcohol T1	.016				-.044	-.044	.097	-.051	-.050	.099	-.046	-.045	.100
	Alcohol T4					-.082	-.067	.080	-.087	-.071	.081	-.095	-.077	.082
	IPAQ T1					.055	.017	.024	.055	.017	.024	.060	.018	.025
3	Stress	.004							.082	.062	.068	.084	.063	.068
	Self-Compassion								.040	.034	.076	.044	.037	.076
4	Stress x Self-Compassion	.003										.054	.005	.007

* $p < .05$.** $p < .01$.*** $p < .001$.

To further probe these findings, a simple slopes analysis was performed to determine the effect of stress on BMI change at low (-1 SD below mean), mean, and high (+1 SD above the mean) levels of self-compassion, where t-tests were used to determine if the slope of each regression line differed significantly from zero. At low levels of self-compassion, the slope of the effect of stress on BMI change was significant ($b = .05$, $SE = .02$, $t = 2.16$, $p = .03$). At mean levels ($b = .02$, $SE = .02$, $t = 1.02$, $p = .31$) and high levels ($b = -.01$, $SE = .02$, $t = .63$, $p = .53$) of self-compassion the slope was not significantly different from zero. The interaction effect is plotted in Figure 1. For participants with low levels of self-compassion BMI increased significantly from Time 1 to Time 4 as a function of increased stress. For participants with mean levels of self-compassion, BMI change increased non-significantly from Time 1 to Time 4 as a function of increased stress. For participants with high levels of self-compassion, there was a non-significant decrease in BMI change from Time 1 to Time 4 as stress increased.

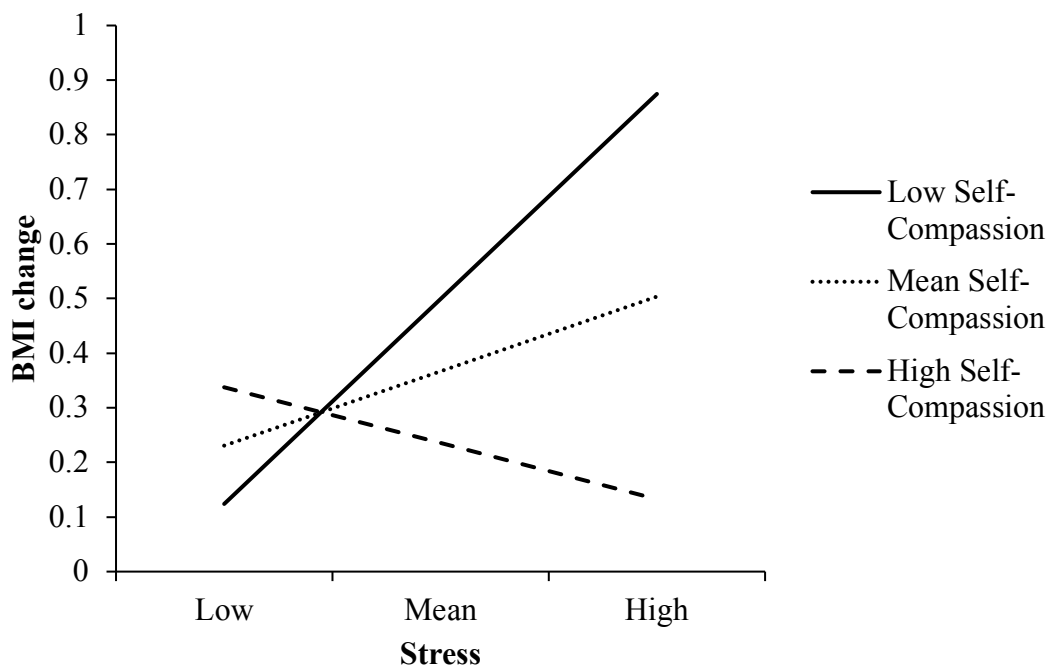


Figure 1. Interaction effect of self-compassion and stress on BMI change.

Meats, fat, and snacks intake. None of the health behaviour variables nor any of the demographic variables were significantly correlated with a change in intake of meats, fat, and snacks (see Table 3), hence no covariates were entered in the regression analysis. Table 3 shows that average stress levels and self-compassion did not significantly predict a change in intake of meats, fat, and snacks. When the interaction term between stress and self-compassion was added into the regression, the result was non-significant ($p = .06$).

Fruit and vegetable intake. Alcohol intake at Time 1 and Time 4 and physical activity at Time 1 were significantly correlated with a change in fruit and vegetable intake (see Table 3) and were therefore included as covariates (along with baseline Time 1 fruit and vegetable intake) in the regression analysis. Table 3 shows that average stress and self-compassion did not significantly predict a change in intake of fruit and vegetables. The interaction term also did not produce a significant result. Overall fruit and vegetable intake did decrease significantly from Time 1 to Time 4, however this does not appear to be due to either stress or self-compassion, or a combination of the two.

Follow-up Results

BMI and weight change: Time 4 to follow-up Time 5

From Time 4 to follow up, 91.2% of students experienced a change in weight. Weight gain was experienced by 63.7% of participants, 27.5% lost weight, and 8.8% had no change in weight (defined as either zero change, or less than 1kg of weight gain or loss). On average, students gained 2.58kg from Time 4 to follow-up at Time 5 ($SD = 5.34$, range = -12 to 20kg). This is consistent with predictions that weight gain would continue post first year. Mean weight increased significantly from Time 4 ($M = 65.38$, $SD = 13.82$) to follow-up ($M = 67.97$, $SD = 14.83$), $t(90) = -4.62$, $p < .001$. From Time 4 to follow-up mean BMI increased again

significantly from 23.01 at Time 4 to 23.79 at Time 5 ($t(90) = -3.94, p = .000$). Categories of BMIs at follow-up were 5.5% underweight (compared to 9.1% at Time 4), 68.1% normal (60.8% at Time 4), 18.7% overweight (23.8% at Time 4) and 7.7% obese (6.3% at Time 4). Table 4 shows correlations between health behaviours in the first year of university, and BMI at all time points. As can be seen, none of the health behaviours assessed during the first year correlate with BMI at Time 5, or BMI change between Time 4 to Time 5. However, average stress experienced during the first year positively correlated with both BMI at Time 5, and with overall change in BMI from Time 1 to Time 5.

Table 4

Correlation table: Time 1 and 4 variables with BMI outcomes

		BMI T1	BMI T4	BMI T5	BMI change T4 - T5	BMI change T1 - T5
1	Sex	.10	.10	.10	.03	.03
2	Age (Time 1)	.03	.01	-.02	-.07	-.11
3	Living Situation	.13	.13	.11	.01	.00
4	Self-Compassion	-.15	.15	-.20	-.16	-.15
5	BMI T1	1	.94**	.88**	.14	.05
6	BMI T4	.94**	1	.91**	.09	.21*
7	BMI T1 - T4 change score	-.13	.21*	.12	-.15	.49**
8	Stress	.11	.15	.21*	.18	.24*
9	Meats, Fats and Snacks T1	-.04	-.08	-.03	.08	.00
10	Meats, Fats and Snacks T4	-.08	-.08	-.05	.06	.04
11	Meats, Fats and Snacks change score	-.05	-.01	-.03	-.06	.02
12	Fruit and Vegetables T1	-.06	-.09	-.08	.00	-.05
13	Fruit and Vegetables T4	-.07	-.08	-.04	.06	.04
14	Fruit and Vegetables change score	.00	.02	.03	.04	.06
15	IPAQ T1	.02	-.02	.03	.11	.03
16	IPAQ T4	.03	-.02	.06	.18	.07
17	IPAQ change score	.00	.00	.02	.05	.04
18	Alcohol T1	.06	.06	.05	-.01	.01
19	Alcohol T4	.05	.04	.07	.06	.05
20	Alcohol change score	-.01	-.02	.02	.08	.04
	<i>M</i>	22.81	23.34	23.79	.78	1.27
	<i>SD</i>	4.12	4.21	4.53	1.89	2.15

Note. Sex: 1 = male; 2 = female.

Living situation: 1 = Living at home with parents; 2 = living away from home (flatting, halls of residence, other)

* $p < .05$.

** $p < .01$.

The moderating role of self-compassion

As none of the health behaviour or demographic variables were correlated with BMI change from Time 4 to Time 5, nor with BMI change from Time 1 to Time 5, no covariates were entered into the regression model except for baseline (Time 1) BMI. Table 5 shows that self-compassion and stress experienced during the first year did not predict BMI change from Time 4 to Time 5, nor BMI change from Time 1 to Time 5. The main effects of self-compassion and stress on BMI outcomes were non-significant (although the relation between stress and BMI change between T1 and T5 nearly reached significance, $p = .054$), and the interaction term also produced a non-significant result.

Table 5*Interaction of stress and self-compassion on BMI change*

		R ² Δ	Step 1			Step 2			Step 3		
			β	b	SE	β	b	SE	β	b	SE
BMI change T4 - T5											
1	BMI T4	.010	.098	.047	.051	.068	.032	.051	.056	.026	.052
2	Stress	.037				.162	.043	.035	.155	.041	.035
	Self-Compassion					-.047	-.013	.037	-.060	-.017	.038
3	Stress x Self-Compassion	.006							-.079	-.003	.004
BMI change T1 - T5											
1	BMI T1	.003	.053	.029	.059	.027	.015	.058	.010	.006	.058
2	Stress	.064				.258	.077	.039	.243	.073	.039
	Self-Compassion					.006	.002	.042	.017	-.005	.042
3	Stress x Self-Compassion	.018							-.137	-.006	.005

* $p < .05$.** $p < .01$.

Discussion

The present study sought to examine changes in BMI, stress, and eating behaviours in a sample of university students across their first year, with a BMI follow-up two years later. Self-compassion was investigated as a potential moderator in the relationships between stress and first year BMI change, and stress and eating behaviour. The moderating role of self-compassion on stress experienced during first year of university and weight change at 2-year follow-up was also examined.

Changes in BMI and Eating Behaviours (Hypotheses One and Two)

This study found that during the first year of university, average weight gain was 1.61kg and average BMI increased from 22.8 at the beginning of the university year to 23.3 by the end, confirming the hypothesis that students would on average experience weight gain across the first year. This finding is much less than the “freshman 15” (6.8kg) but in keeping with other studies of first year university weight gain that found between 1.1kg and 1.75kg, and in line with previous research, some lost weight and some maintained their weight (Boyce & Kuijer, 2015; Vella-Zarb & Elgar, 2009). As indicated by McTigue et al. (2002), even being mild to moderately overweight in young adulthood increases risk of obesity by mid-life, thus it was of concern that over the course of the first year the percentage of normal BMIs decreased, while the percentage of overweight and obese increased. At Time 1, 18.2% were overweight and 4.9% were obese. By Time 4, 23.8% were overweight and 6.3% obese.

Consistent with previous literature that student weight gain continues in subsequent years (Pope et al., 2016), students continued to gain weight into their third year of university. In the follow-up sample (n = 91) students on average gained 2.58kg from Time 4 to Time 5 follow-up, and mean BMI increased again from 23.01 to 23.79. Similar to what was observed in the first

year of university, at follow-up the percentage of normal weight BMIs had further decreased from Time 4, while the percentage of overweight and obese had increased. Categories of BMIs at follow-up were 5.5% underweight (compared to 9.1% at Time 4), 68.1% normal (60.8% at Time 4), 18.7% overweight (23.8% at Time 4) and 7.7% obese (6.3% at Time 4).

Drop out analysis indicated participants who dropped out between Time 1 and Time 4 had higher average BMIs than those who completed Time 4, as did those who dropped out between Time 4 and Time 5 compared to those who completed Time 5. Due to the importance of baseline BMI on weight gain, as those with higher BMI at baseline tend to gain disproportionately more weight during the first year (Boyce & Kuijer, 2015; Kasperek et al., 2008), it is likely that average weight gain and frequencies of overweight and obese from both Time 1 to Time 4, and Time 4 to Time 5 would be larger had the full sample been retained.

The hypothesis that over their first year at university students would decrease their intake of fruit and vegetable and increase their intake of meats, fat, and snacks was partially supported. As previously stated, students often decrease their intake of fruit and vegetables over the first year of university (Kasperek et al., 2008) and this was confirmed in the current study. Conversely, the hypothesis that unhealthy eating behaviours (meats, fat, and snack intake) would increase was not supported. In an observational study by Wansink, Cao, Saini, Shimizu, and Just (2013) transactions were recorded at a university dining hall. Researchers found that with each passing week during the university term, food choices became progressively unhealthier. However, a similar effect was not found in the present study.

BMI change across the year was found to be unrelated to changes in eating behaviours, physical activity, or alcohol intake. It is possible that there were very small changes to each of these health behaviours that cumulatively resulted in BMI change, but the current study's design

did not have the ability to detect. A larger sample may have found significant results. It is also possible that health behaviours had already changed in the time since finishing high school to when they completed the first survey at Time 1 in February, and the stable continuation of these new habits (for example unhealthier eating, less physical activity, increased alcohol intake compared to their final year of high school) throughout the first year of university contributed to weight gain.

Stress: Correlations with BMI and Eating Behaviours (Hypothesis Three)

It was hypothesised that perceived stress would be positively correlated with BMI change – those higher in stress would experience more weight gain. It was also hypothesised that those higher in perceived stress would have unhealthier eating habits: lower intake of fruit and vegetables, and higher intake of meats, fat, and snacks. These predictions were not supported by the results. Average perceived stress over the course of the first year of university was not correlated with BMI change from Time 1 to Time 4. This finding mirrors the extensive research on the complicated relationship between stress and weight change. For example, a meta-analysis by Wardle et al. (2011) found that among studies on stress and weight change, 25% reported weight gain, 6% reported weight loss and 69% reported no direct relationship between stress and weight change. However, in this study, average stress experienced during the first year was correlated with overall BMI change from Time 1 to Time 5, and there were small but significant positive correlations between average stress levels and BMI at Time 1 and Time 4. Stress levels were not correlated with change in eating behaviours over time, nor with eating behaviours at Time 1 or Time 4. Previous research is mixed with regard to the effect of stress on eating behaviours, and as indicated by Oliver and Wardle (1999), roughly equal numbers of people

report eating more when stressed as eating less. Although fruit and vegetable intake did decrease over the year, this does not appear to be due to stress.

Self-compassion: Correlations with Stress, BMI, and Eating Behaviours (Hypothesis Four)

This study confirmed previous research linking higher self-compassion to lower levels of perceived stress. The literature has indicated that self-compassion (both trait self-compassion and self-compassion induced in the laboratory and through clinical interventions) is linked to a host of positive psychological and behavioural outcomes (Barnard & Curry, 2011), and this was reflected in the current study. Self-compassion was strongly negatively correlated with perceived stress over the course of the year ($r = -.58, p < .01$). Other studies have found significant correlations ranging from $r = -.36$ (Finlay-Jones et al., 2015) to $r = -.80$ (Homan & Sirois, 2017).

The hypothesis that self-compassion would be negatively correlated with BMI was also confirmed. In line with Taylor et al. (2015), small negative correlations between self-compassion and BMI were found at Time 1 and Time 4.

The prediction that self-compassion would be linked to healthier eating (higher intake of fruit and vegetables and lower intake of meats, fat, and snacks) was not supported in the current study. Self-compassion was not correlated with fruit and vegetable intake nor with meats, fat, and snack intake. Previous studies have found that levels of trait self-compassion correlated with the Wellness Behaviour Inventory (Dunne, Sheffield, & Chilcot, 2016; Sirois et al., 2015), and the Health Promoting Lifestyle Profile in which 9 questions on healthy eating (high fruit and vegetable intake, low intake of junk food) was a component (Homan & Sirois, 2017).

The meta-analysis by Sirois et al. (2015) used 15 independent samples with a total $n = 3252$ to investigate the effect of self-compassion on health behaviours using the Wellness

Behaviour Inventory. This scale was comprised of 10 questions about healthy eating, exercise and other health behaviours. They found a small but significant effect size of $r = .20$ for the correlation between self-compassion and health behaviours. It is possible that small effects of self-compassion on fruit and vegetable intake and meat, fats, and snacks intake were present but were not detectable by the current study's design and measures. Other studies (Rahimi-Ardabili et al., 2017) have linked self-compassion to a wide range of positive eating behaviours, and low self-compassion to eating disorders. The current study did not assess portion size (only days per week a particular food was consumed), and self-compassion has been found to be negatively correlated with bingeing behaviours (Webb & Forman, 2013). Moreover, self-compassion is positively correlated with intuitive eating (Schoenefeld & Webb, 2013), and it could be possible that while the frequency of foods consumed by those high versus low in self-compassion was not significantly different in the current study, those high in self-compassion may naturally self-regulate their portion sizes of unhealthy foods. More research is needed to determine if the relationship between self-compassion and intuitive eating has an effect on food choice and portion sizes.

The Moderating Role of Self-compassion (Hypothesis Five)

Self-compassion, stress, and BMI change (first year and follow-up). As predicted, a significant moderation effect of self-compassion on stress and BMI change was observed. Participants low on self-compassion saw an increase in BMI as a function of increased stress. This effect was not observed at mean levels of self-compassion. At high levels of self-compassion, a small non-significant decrease in BMI was observed as a function of increased stress. This is a novel finding that to date has not been explored in the literature. This finding suggests that those low in self-compassion are responding differently to stress than those with

mean or high levels of self-compassion, and this difference in stress response results in an increase in BMI for those with low self-compassion. Differences in stress response for those low in self-compassion could be behavioural, neuroendocrine, or a combination of the two. Theories and pathways to BMI change for those low in self-compassion and high in stress will be discussed in the next section.

Self-compassion did not moderate the relationship between stress and BMI change at Time 5 follow-up. Both moderation models for change in BMI from Time 4 to Time 5, and from Time 1 to Time 5 were non-significant. However, stress during the first year of university was positively correlated with BMI at Time 5, and with change in BMI from Time 1 to Time 5. In the moderation model, the effect of first year stress on BMI change from Time 1 to Time 5, controlling for baseline BMI approached significance ($p = .054$).

Self-compassion appears to moderate the stress to weight gain relationship *while* the stress is being experienced in the short to medium term. The interaction effects of self-compassion and stress experienced over the course of 8 months in the initial study disappear when using longer-term (2-year follow-up) weight change as the dependent variable. There are a few possible reasons for this finding.

Stress levels may have decreased during the second and third year of university as students adjust to the university lifestyle, living situations, work/study balance, and become more proficient at time management of assignments and projects. Future research could follow students throughout their time at university, measuring stress levels during the second and third years. Additionally, drop out analysis indicated those who dropped out between Time 4 and follow-up at Time 5 had higher levels of average perceived stress from Time 1 to Time 4. This could potentially affect the moderation results by reducing the ability to find a significant effect;

those most affected by stress during the first year did not participate in the follow-up analysis. Aside from stress, weight gain itself seems to predict further weight gain, whereby those with higher baseline BMIs tend to gain disproportionately more weight over time (Boyce & Kuijer, 2015).

Self-compassion, stress, and meat, fat, and snack intake (first year). As stress is often linked to unhealthy food choices (Ng & Jeffery, 2003; Sinha & Jastreboff, 2013), and self-compassion has been found to buffer negative stress outcomes (Breines et al., 2015; Zhang et al., 2016), it was expected that self-compassion would moderate the relationship between stress and meat, fat, and snack intake (those with lower levels of self-compassion would increase their intake, those with high self-compassion would not increase their intake). However, self-compassion did not significantly moderate the relationship between stress and intake of meat, fat, and snacks. The p value for the interaction term approached significance, however ($p = .059$).

The Block Food Frequency scale included several questions related to specific meats and condiment intake (see Appendix H) but there is no evidence to suggest that meat or condiment intake increases due to stress. Although junk foods were a component of the meat, fat, and snacks scale, is possible that the use of a highly palatable foods scale that solely focuses on junk foods, sweets, and snacks may uncover a significant effect. Participants were not asked if they were vegetarian or vegan, so due to the rising rates of adoption of these kinds of diets with 10.5% of New Zealanders identifying as “always or mostly vegetarian” according to one market research poll (Roy Morgan Research, 2016), this could have had an effect on meat intake results. It is also possible that eating behaviour intentions may be affecting results. Someone with high levels of self-compassion, but for whom healthy eating is not an important goal may behave differently while under stress than someone high in self-compassion for whom healthy eating is

an important goal. As self-compassion is related to better self-regulation (Sirois, 2015) and intrinsic motivation and mastery goals (Neff, Hsieh, & Dejitterat, 2005; Terry & Leary, 2011), whether or not someone has healthy eating goals and intentions could affect results, perhaps by being more likely to continue to eat healthy while under stress. The opposite effect could be found for those lower in self-compassion, but who have healthy eating goals, whereby they may abandon their healthy eating goals under stress. Furthermore, Mantzios and Egan (2017) theorised that the self-kindness aspect of self-compassion may not always have a positive effect on eating behaviours, for example by treating yourself to chocolate or other unhealthy foods after a stressful day because you “deserve it”, and that this may become problematic if repeated frequently. Probing the current results further by investigating healthy eating intentions could provide more insight.

Self-compassion, stress, and fruit and vegetable intake (first year). Based on the buffering effect of self-compassion on negative stress outcomes, it was proposed that those higher in self-compassion would not see a decrease in fruit and vegetable intake as a result of stress, whereas those lower in self-compassion would see a decrease in fruit and vegetable intake. However, this effect was not present in the current data. Although fruit and vegetable intake decreased significantly during the first year of university from Time 1 to Time 4, self-compassion did not moderate the relationship between stress and change in fruit and vegetable intake across the year. As discussed above, healthy eating intentions could also be investigated with regard to fruit and vegetable intake, and whether they have an effect on results.

Interestingly, fruit and vegetable intake was positively correlated with physical activity at both Time 1 and Time 4. Time 1 physical activity was correlated with the change score in fruit and vegetable intake, and thus entered as a covariate into the regression. This is in keeping with

studies showing that positive health behaviours tend to cluster (Colby et al., 2017). According to Colby et al., (2017) health risk behaviours can also cluster, and some evidence of this was found in the current study: higher alcohol intake at Time 1 was associated with a decrease in fruit and vegetable intake over the year and therefore was also entered as a covariate into the regression. However, alcohol also had a small positive correlation with current fruit and vegetable intake at both time points, which contradicts the clustering effect. Perhaps, contrary to the clustering hypothesis, some health-conscious students who have higher alcohol intake may try to negate the negative health effects of alcohol by eating more fruit and vegetables.

Why Does Self-compassion Moderate the Stress-BMI Relationship but not the Stress-eating Relationship?

In the current study self-compassion moderated the stress-BMI change relationship but not the stress-eating relationships. Three potential pathways to BMI change are explored.

One aim of the study, had significant moderation effects also been found for fruit and vegetable, and meats, fat, and snack intake, was to follow up with a mediation-moderation analysis to determine if self-compassion moderates the relationship between stress and BMI change via an increase in meats, fat, and snacks, and a decrease in fruit and vegetable consumption. Although these effects were not found in the current study, the interaction of stress and self-compassion could still be affecting eating behaviours. There were some limitations with how eating behaviours were measured in the current study. The use of the Block Food Frequency questionnaire may not have accurately captured eating behaviours in the sample. The questionnaire asked participants to rate how many times per week (or month) they consumed a particular food, with specific examples of foods listed. The scale did not examine portion sizes for each type of food, and it is possible that while the frequency of foods consumed did not

change for meats, fat, and snacks, the portion sizes may have changed. For example, as discussed above, those low on self-compassion are more prone to binge eating behaviour (Webb & Forman, 2013), and binge eating behaviour can manifest as a result of stress (Sulkowski et al., 2011). It is also possible, as discussed above, that those low on self-compassion consumed more junk foods when stress levels were high, but the inclusion of meat, oils, and condiments in the survey clouded the results.

Another possible pathway to BMI change as a result of self-compassion and stress is that low self-compassion and high stress could have small negative effects on a wide range of health behaviours. It is possible that in the present study, small but significant effects may be present but undetectable with the current sample size. These small effects could cumulatively have an effect on BMI change, such that those low on self-compassion are slightly decreasing their engagement in health behaviours (lower engagement in physical activity, higher alcohol intake, unhealthier eating patterns) while experiencing stress. There could also be other health behaviours affecting BMI change that weren't measured by the current study. One example is sleep. In a study by Hu et al. (2018), trait levels of self-compassion were found to buffer the relationship between stress and sleep latency, where experiencing stress during the day was associated with taking longer to fall asleep, except for participants who were high on self-compassion. Those high on self-compassion also reported feeling more alert upon waking. If self-compassion buffers the relationship between stress and sleep issues, it is possible that this could have an effect on stress related BMI change; sleep problems have been associated with increased BMI and risk of obesity (Taheri, Lin, Austin, Young, & Mignot, 2004).

A third pathway to weight change is the role of cortisol on adiposity. Cortisol has been implicated as a causal factor for both obesity risk mediated through increased caloric intake (not

measured by the current study), and also appears to directly contribute to abdominal fat deposits and metabolic abnormalities over and above that explained by diet (Björntorp, 2001). It is possible that self-compassion levels affect the production of cortisol during stress. There is limited, provisional evidence that self-compassion influences cortisol levels. A study by Rockliff, Gilbert, McEwan, Lightman, and Glover (2008), employed a self-compassion intervention using a compassion focused imagery task and found a decrease in cortisol after the compassion imagery intervention, for participants who had high heart-rate variability. Subsequently they found that those with high heart rate variability and lower cortisol were lower on the self-criticism subscale (the inverse of self-kindness). However more research is needed as this appears to be the only study that has found a link between a self-compassion intervention and cortisol reactivity, and as it was a pilot study with a small sample size ($n = 22$) and no control group, limited conclusions can be taken from these findings. Arch et al. (2014) found that although self-compassion moderated heart rate variability response to the Trier Social Stress test, they did not find a similar effect on cortisol levels. Mindfulness (one of the three subscale components of self-compassion) has been more extensively studied with regard to its role in cortisol regulation. One study found that a mindfulness intervention aimed at reducing stress related eating among obese women reduced cortisol awakening response and helped them maintain their weight, compared to obese waitlist control participants whose cortisol responses remained stable, and whose weight increased during the waitlisted period (Daubenmier et al., 2011). Trait mindfulness has been found to modulate cortisol responses to a laboratory stressor, such that those higher in mindfulness had lower cortisol responses to the Trier Social Stress test, and also experienced lower anxiety and negative affect (Brown, Weinstein, & Creswell, 2012). What these studies show, is that self-compassion and mindfulness may have effects on cortisol

levels for some individuals, but research is mixed. If low self-compassion is indeed related to higher cortisol reactivity under stress, this could provide a possible explanatory pathway for why in the current study BMI increased for those with high stress and low self-compassion, but frequency of fruit, vegetable, meat, fat, and snack intake did not: through increased caloric intake and the through the direct effect of cortisol on abdominal fat deposits and metabolic abnormalities. However, much more research is needed in the area of self-compassion and cortisol response. More research is also needed to determine whether self-compassion as a single construct predicts additional variance in cortisol stress responses over and above that of mindfulness, and to examine if the three self-compassion subscales (self-kindness, mindfulness, and common humanity) differentially affect the outcome of stress on BMI change.

Strengths

One strength of the study was its longitudinal design. Much of the literature is cross-sectional, and while still correlational in nature, longitudinal designs can provide more insight into the nature of relationships between variables over time. Additionally, the current study included a follow-up measure. It is common to follow students throughout their first year only, whereas examining whether patterns of weight change continue in subsequent university years is important for projections into adulthood.

Another strength of the study is the use of a moderation analysis. While still correlational, a moderation analysis can provide a stronger argument for the relationship between variables over and above that of simple or multiple regression. However, results should still be interpreted with caution, and more research using both experimental designs and designs that include a self-compassion intervention are needed.

This longitudinal model also adds to the body of evidence that stress and BMI are intrinsically linked: while stress was not correlated with *change* in BMI across the first year, it was correlated with BMI at Time 1 and Time 4. Whether stress causes higher BMI, or higher BMI increases the likelihood of experiencing higher levels of stress cannot be determined from the current study. It is possible that stress and BMI are related such that both promote the increase of the other – stress can directly affect hormone levels and deposits of abdominal adiposity, and hormonally active abdominal adiposity can increase stress responses due to increased circulation of cortisol (Björntorp, 2001).

Limitations

There were some limitations with the current study. One limitation is that the use of short-form scale meant that we were not able to isolate effects of each of the three components of self-compassion (self-kindness, mindfulness, and common humanity) and their effects on stress induced BMI change. Although the short-form scale has near perfect correlation with the original long-form self-compassion scale, it is not suitable for breaking the scale down into the three components (Raes et al., 2011). The use of the original long form self-compassion scale (Neff, 2003a), would mean that the three components (self-kindness, mindfulness, and common humanity) could be studied separately to determine whether the variance in BMI change as a result of self-compassion and stress is most strongly predicted by one, two or all three of the components. This could be important for the development of interventions to prevent weight gain as it would enable intervention designers to focus on the parts of the self-compassion construct that explain the most variance in the buffering effect on the stress to BMI change relationship.

Another limitation was use of the Block Food Frequency meats, fat, snacks subscale. In general, eating behaviour is difficult to accurately measure, and Food Frequency Questionnaires

tend have issues with reliability; people may not accurately remember what or how much they ate over the past week or month (Thompson, Subar, Loria, Reedy, & Baranowski, 2010). Moreover, the inclusion of meat and condiments in this scale may have clouded the results, and therefore affected the ability to find the effect of self-compassion and stress on highly palatable food intake. There is no evidence that meat or condiment intake increases as a function of stress. The moderation effect of self-compassion on stress and meat, fat, and snack intake stopped just short of being significant ($p = .059$), however with a properly validated junk food scale, it is possible that more robust results may be found. Alternatively, the use of a specific stress-eating scale may also yield stronger findings.

As with all self-report surveys, desirability bias is a potential issue. People may overstate their fruit and vegetable intake and understate their meat, fat, and snack intake due to embarrassment over their eating behaviour, or perhaps due to being in denial about their current eating habits. And, as with much social science research, participants self-selected to participate in a study they knew was focused on health behaviours, perhaps meaning that they had more interest in the topic (and potentially healthier behaviours) than those who did not opt to participate.

Participants were not asked if they were currently taking any medication that may affect their weight (oral contraceptives, steroids, anti-depressants), if they had any medical conditions that could affect their weight, or if they were currently dieting or attempting to lose or gain weight. They were not asked if they were currently undergoing any therapies that may potentially increase self-compassion or if they currently practiced any stress relief practices such as mindfulness, mediation, or yoga.

As explained in the method section, the high rate of non-completion of the minutes per day section of the IPAQ questionnaire meant that minutes per day for each type of exercise had to be excluded from the analysis, and only days per week used. This loss of data could have affected correlations between IPAQ and other study variables.

Finally, as discussed earlier, attrition rates from Time 1 to Time 4, and from Time 4 to Time 5 follow-up were high. Participants who dropped out between Time 1 and Time 4 had significantly higher BMI than those who completed Time 4, which may have affected results such as the ability to find links between study variables and BMI. Participants who dropped out from Time 4 to Time 5 had higher levels of perceived stress during their first year, potentially influencing the ability to find a significant interaction between stress and self-compassion on Time 5 BMI change.

Implications for Interventions

The concept of self-compassion is one of a collection of behaviours and cognitive processes native to Eastern philosophical traditions that have been gaining traction within the scientific community. Practices such as yoga, meditation, mindfulness, and self-compassion have crossed over from traditionally Buddhist practices to therapeutic psychological practices worthy of scientific study (Neff, 2003b).

The ability to experimentally induce self-compassionate states in the laboratory (Adams & Leary, 2007) and to raise self-compassion levels via interventions has resulted in the use self-compassion therapies in clinical populations (Neff & Germer, 2013). Interventions aimed at increasing self-compassion have had success. Participants of a Mindful Self-Compassion intervention aimed at increasing levels of self-compassion and general well-being reported significant post-intervention gains in self-compassion, mindfulness, and wellbeing compared to

controls, and these gains were maintained at follow-ups of six months and one year (Neff & Germer, 2013). Self-compassion and mindfulness have been described as “third wave cognitive-behavioural approaches” due to their success when incorporated into behavioural interventions (Rahimi-Ardabili et al., 2017).

In the current study, those low in self-compassion experienced more weight gain when experiencing the same level of stress as those average or high in self-compassion. Those high in self-compassion experienced less stress over-all and tended to have lower BMIs. Therefore, interventions aimed at managing stress, promoting healthy behaviours, and preventing weight gain in young people and university students should involve concurrent training in self-compassion. As discussed above, self-compassion moderated the stress to BMI change relationship *while* the stress was being experienced. Those low in self-compassion saw an increase in weight while experiencing stress. This effect was not observed for future BMI change. This suggests that interventions to increase self-compassion should be targeted at people currently experiencing stressful circumstances to prevent weight gain in the short to medium term. Interventions could be targeted at raising self-compassion in at-risk students to enable them to both better cope with stress, and to prevent subsequent weight gain. If these findings generalise to populations outside first year students, then self-compassion could be a useful tool in workplace well-being initiatives that aim to reduce employee job stress and prevent weight gain.

Directions for Future Research

To help determine pathways of causation, future research should further investigate self-compassion, stress, eating behaviour, and weight gain by employing an experimental model with a self-compassion intervention. The use of more accurate measures of eating and health

behaviours, perhaps using a calorie and macronutrient counting smartphone app and a wearable fitness tracker, could be employed to investigate if the relationship between variables in the present study remain, and to further probe the moderation effect of stress and self-compassion on meats, fat, and snacks that approached significance in the current study. Future research should take samples from a range of populations (for example workers, caregivers, high school students, or clinical populations) to determine if the results found in this study are generalisable beyond effects found in first year university students. In the current study (as is the case in much social science research) the sample was largely female and New Zealand European. Future research should endeavour to recruit more males and participants of different ethnicities.

As the role of self-compassion in cortisol and biochemical stress responses is understudied, further research should examine the roles of cortisol and neuropeptide Y, and effects of these on hunger hormones such as leptin and ghrelin (Adam & Epel, 2007) using trait or intervention self-compassion as a moderator.

Due to perceptions of stress differentially activating either the hypothalamus pituitary axis (HPA), or the sympathetic-adrenomedullary axis (SAM) (Adam & Epel, 2007), and the strong negative correlation found between stress and self-compassion in the current study, future research could investigate whether self-compassion levels affect whether a particular stressor is perceived as a threat (i.e. activating the HPA axis) or a challenge (i.e. activating the SAM axis) and the effect of this perception on cortisol responses and stress eating behaviours.

Conclusion

It is clear from the present study that the university years are associated with weight gain. It is also evident that self-compassion levels affect both stress and BMI. Self-compassion was negatively correlated with both stress and BMI and was found to buffer the relationship between

stress and BMI change. It is also possible that, using more rigorous dietary intake measurement methods, a link may be found between self-compassion, stress, and the intake of highly palatable foods, as the moderation effect of self-compassion on stress and intake of meats, fat, and snacks approached significance in the current study.

More studies, especially experimental designs that involve self-compassion interventions, are needed to determine the causal relationships between these variables. As obesity is continually on the rise, and the health consequences of obesity are reaching crisis point for national health systems, uncovering potential causal mechanisms of weight change in various populations is important for developing both weight loss and weight gain prevention interventions. If young adults can be taught self-compassionate, adaptive, ways of coping with stress and managing health behaviours, this may enable them to form long lasting habits that reduce the risk of obesity and disease throughout adulthood.

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Appendix A: Ethics Approval 2015



HUMAN ETHICS COMMITTEE

Secretary, Lynda Griffioen
Email: human-ethics@canterbury.ac.nz

Ref: HEC 2015/02

16 February 2015

Associate Professor Roeline Kuijer
Department of Psychology
UNIVERSITY OF CANTERBURY

Dear Roeline

The Human Ethics Committee advises that your research proposal "Perceived stress and freshman weight change" has been considered and approved.

Please note that this approval is subject to the incorporation of the amendments you have provided in your email of 12 February 2015.

Best wishes for your project.

Yours sincerely

A handwritten signature in black ink, appearing to read 'L. MacDonald'.

Lindsey MacDonald
Chair
University of Canterbury Human Ethics Committee

Appendix B: Ethics Approval 2017 Follow-Up



HUMAN ETHICS COMMITTEE

Secretary, Rebecca Robinson
Telephone: +64 03 369 4588, Extn 94588
Email: human-ethics@canterbury.ac.nz

Ref: HEC 2017/97

2 October 2017

Katherine Sullivan
Psychology
UNIVERSITY OF CANTERBURY

Dear Katherine

The Human Ethics Committee advises that your research proposal "Stress, Health Behaviours and Weight Change in University Students: a Three Year Follow-up" has been considered and approved.

Please note that this approval is subject to the incorporation of the amendments you have provided in your emails of 21st and 26th September 2017.

Best wishes for your project.

Yours sincerely

R. Robinson
pp.

Associate Professor Jane Maidment
Chair
University of Canterbury Human Ethics Committee

Appendix C: Invitation Email 2015

Invitation Email

Welcome to the University of Canterbury, we hope that you will enjoy your year!

Research is a vibrant part of UC and we would like to ask you to take part.

We are looking for first-year university students who are interested in participating in a study looking at changes in health behaviours and well-being of students during their first year at university. Participation involves the completion of one online survey now, and three more brief online surveys throughout 2015.

If you decide to participate and complete survey number 1 (link below), you will go into a draw to win a Westfield or Petrol voucher (one \$100 voucher and one \$50 voucher available)! There are also vouchers available for the other three surveys. If you complete all 4 online surveys then you have the chance to win an iPad-mini in November!!

The surveys have been reviewed and approved by the **University of Canterbury Human Ethics Committee**, and all your data will be confidential. Participating in this study is 100% voluntary. For more information about the study and access to the first online survey, please click on the link below.

If you have any questions, please direct them to Associate Professor Roeline Kuijer (roeline.kuijer@canterbury.ac.nz) who works at the Department of Psychology.

Many thanks,

Roeline Kuijer
Jessica Boyce

Appendix D: Information Sheet 2015



Health Behaviours of First-Year University Students

Information sheet

Thank you for your interest in the study.

The aim of this study is to examine changes in health behaviours (for example eating behaviours, sleep) and stress levels in students during their first year at university

What does participation involve?

Participation in the study involves completing *four online* questionnaires spread throughout the year.

Questionnaire 1 (15-20 minutes): Now, February 2015.

Questionnaire 2 (10-15 minutes): May, 2015

Questionnaire 3 (10-15 minutes): August, 2015

Questionnaire 4 (10-15 minutes): November 2015

For each survey you complete, you will get a chance to win a Westfield or Petrol voucher. We have one \$100 and one \$50 voucher available for Questionnaire 1 and two \$50 vouchers for each of the following questionnaires. Students who complete *all* four online surveys will go into a draw to win an iPad-mini.

Who can participate?

Students enrolled at the University of Canterbury for whom 2015 is their first year at university. STAR students are excluded.

Confidentiality

The results of the project may be published, but you may be assured of the complete confidentiality of the data gathered in this investigation: your identity will not be made public. In order to be able to contact you for the subsequent questionnaires, we will ask you for your email address and your UC student identification number at the beginning of the questionnaire. We

will not ask for any other identifying information. Your email address will be kept in a separate file (with your student ID number) once the data for questionnaire 1 are downloaded. At each follow-up questionnaire we will ask you to enter your student ID number so that we can match your answers from the first questionnaire to your answers on the follow-up questionnaires. We will replace your student ID by a random three-digit code once the data from all 4 online surveys are downloaded in November 2015. Data will be securely stored for 10 years and will then be destroyed.

Risks

It is not anticipated that participation in the study will involve any risk to you. However, if after completing this questionnaire you are concerned about your health behaviours or you experience distress and want to talk to someone, we suggest you contact your general practitioner or the Health Centre on campus. The Health Centre on campus offers counselling services for university students and can be contacted by calling the Student Health Reception on (03) 364 2402 between 8:30 am and 5:00 pm every weekday or by calling into the reception area.

Right to Withdraw

Participation is voluntary, and you have the right to withdraw at any stage without penalty until 30 November 2015. If you withdraw, we will remove all information relating to you. Once all the data from all 4 online surveys are downloaded (November 2015) and your student ID has been replaced with a random three-digit code we will no longer be able to remove your data.

The project is being carried out by Assoc. Prof. Roeline Kuijer from the Department of Psychology, and her colleague Dr. Jessica Boyce. If you are concerned about any of the information provided here or if you have any further questions please do not hesitate to contact Roeline (roeline.kuijer@canterbury.ac.nz).

This project has been reviewed and approved by the University of Canterbury Human Ethics Committee, and participants should address any complaints to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz).

Your participation is much appreciated.

Kind regards,

Roeline Kuijer

Jessica Boyce

CONSENT

I have read and understood the description of the above-named study. On this basis I agree to participate, and I consent to publication of the results of this study with the understanding that confidentiality will be preserved. I understand also that I may at any time withdraw from the study, including withdrawal of any information that I have provided, until 30 November 2015.

- ☐ I agree to participate (please go to the next page to start the questionnaire)
- ☐ I have decided NOT to participate (please exit the questionnaire by closing this window)

Appendix E: Debriefing Sheet 2015



Debriefing Sheet

Thank you for completing the health behaviour questionnaires throughout 2015. We would now like to take the time to fully debrief you upon the nature of your participation and what we were investigating.

The main outcome variable that we were interested in was whether your weight changed between February and October. This is because the transition from high-school to university is a critical period of weight change. Researchers are beginning to investigate how certain variables and interactions between such variables predict changes in weight in first-year students.

We were particularly interested in the link between stress and weight-gain and weight-loss. In the hope of identifying the mechanisms that connect stress to weight-change (e.g., health behaviours) and to inform future intervention strategies, it was our objective to pinpoint the characteristics of students who gain/lose weight during their first year, and why. This is why we asked many questions (not only about stress) about your health behaviours such as eating and exercise.

We did not highlight the direct purpose of our questionnaires when you were recruited in February. Evidence suggests that if participants are aware of a study's purpose then they will respond in a different 'socially desirable' manner and may even attempt to change their answers. We therefore did not tell you that we were mainly interested in weight-change.

If these questionnaires or the topic of our study have caused you any distress, or after this debriefing you are concerned about weight/body image issues and/or you would like advice with respect to changing health behaviours, we suggest that you make contact with one of the following services: your General Practitioner, phone the Healthline (0800-611 116) for advice, or contact Student Health & Counseling **03 364 2402**. **Alternatively you can contact the Psychology Centre (03 343 9627)**, this Clinical Centre offers a wide range of assessment and therapy options for a range of problems.

Once again, thank you for your participation. We would like to remind you that you have the right to withdraw from the study until 30 November 2015, including withdrawal of any information provided.

Sincerely,

Assoc. Prof. Roeline Kuijer

Dr. Jessica Boyce

Appendix F: Invitation Email 2017 Follow-up

Invitation Email

Hi,

My name is Katie Sullivan and I'm a Master of Science student at the University of Canterbury. Three years ago you took part in a study looking at health behaviours of first-year university students. I am now emailing all students who participated in the original study to see if they are interested in completing a follow-up questionnaire, again measuring health behaviours and well-being.

Participation in the follow-up study involves completing an online survey (link below). We understand it is a very busy time of year, so participation will only take about 20 minutes. As a thank you for your time you will receive a \$10 grocery voucher.

The survey has been reviewed and approved by the University of Canterbury Human Ethics Committee, and all your data will be confidential. Participating in this study is 100% voluntary. For more information about the study and access to the online survey, please click on the link below.

If you have any questions, please email me at katherine.sullivan@pg.canterbury.ac.nz or contact my supervisor (who developed the original study), Associate Professor Roeline Kuijer (roeline.kuijer@canterbury.ac.nz). We are happy to answer any questions you may have.

Many thanks,

Katie Sullivan

Appendix G: Information Sheet 2017 Follow-up



Health Behaviours of First-Year University Students: Three year follow-up

Information sheet

In 2015 you took part in a study looking at health behaviours of first-year students. Thank you for your interest in the follow-up measurement of this study. The aim of the current study is to examine changes in health behaviours (for example eating behaviours, exercise, sleep) and stress levels over a period of three years.

What does participation involve?

Participation involves completing an online questionnaire. This questionnaire will take about 20 minutes to complete. You will receive a \$10 grocery or petrol voucher (your choice) as a thank you for your time.

Confidentiality

The results of the project may be published, but you may be assured of the complete confidentiality of the data gathered in this investigation: your identity will not be made public. We will ask for your UC student identification number at the beginning of the questionnaire (if you are no longer a university student and don't remember your student ID you can leave this question blank). We will not ask for any other identifying information. We will replace your student ID by a three-digit code once the data from the survey is downloaded at the end of October 2017. Only my supervisors and I will have access to the data. Data will be securely stored for 5 years, and will then be destroyed. The data will be used for my master's thesis and

may be used for conference presentations and scientific journal articles. A thesis is a public document and will be available through the UC library.

Risks

It is not anticipated that participation in the study will involve any risk to you. However, if after completing this questionnaire you are concerned about your health behaviours or you experience distress and want to talk to someone, we suggest you contact your general practitioner or the Health Centre on campus. The Health Centre on campus offers counselling services for university students and can be contacted by calling the Student Health Reception on (03) 364 2402 between 8:30 am and 5:00 pm every weekday or by calling into the reception area.

Right to Withdraw

Participation is voluntary and you have the right to withdraw at any stage without penalty. If you withdraw, we will remove all information relating to you. However, once data collection has finished (1 November 2017) and your student ID has been replaced by a three-digit code we will no longer be able to remove your data.

The project is being carried out as a requirement for a Master of Science degree in Psychology by Katie Sullivan under the supervision of Assoc. Prof. Roeline Kuijer and Dr. Jessica Kerr. If you are concerned about any of the information provided here or if you have any further questions please do not hesitate to contact Katie (Katherine.sullivan@pg.canterbury.ac.nz) or Roeline (roeline.kuijer@canterbury.ac.nz).

This project has been reviewed and approved by the University of Canterbury Human Ethics Committee, and participants should address any complaints to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz). Your participation is much appreciated.

Kind regards,

Katie Sullivan

CONSENT I have read and understood the description of the above-named study. On this basis I agree to participate, and I consent to publication of the results of this study with the understanding that confidentiality will be preserved. I understand also that I may at any time

withdraw from the study, including withdrawal of any information that I have provided, until 31st October 2017.

- ☐ I agree to participate (please go to the next page to start the questionnaire)
- ☐ I have decided NOT to participate (please exit the questionnaire by closing this window)

Appendix H: Measures

Background information (Time 1 and Time 5)

What is your age? _____

Are you: ☐ male
 ☐ female
 ☐ other

Which ethnic group/s do you belong to? (Time 1 only)

☐ NZ European
☐ NZ Maori
☐ Samoan
☐ Cook Island Maori
☐ Tongan
☐ Niuean
☐ Chinese
☐ Indian
☐ Other: _____

What is your current living arrangement?

☐ Flatting
☐ Hall of residence
☐ Living at home with parents
☐ Living alone
☐ I own my home
☐ Other _____

Are you currently enrolled as a student at the University of Canterbury? (Time 5 only)

☐ yes
☐ no

If yes, I am: ☐ on track to graduate with a Bachelor's degree at the end of this year
 ☐ on track to graduate with a Bachelor's degree next year
 ☐ other: _____

If no, I am now: ☐ enrolled at another university
 ☐ enrolled at an institute for tertiary education other than
 university
 ☐ employed full time
 ☐ other: _____

Self-compassion (Time 1): Self-Compassion Scale (Raes, Pommier, Neff, & Van Gucht, 2011)

Please use the scale provided below to indicate how much each of the following statements reflects how you typically are.

	Almost never	Rarely	Sometimes	Often	Almost always
When I fail at something important to me I become consumed by feelings of inadequacy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I try to be understanding and patient towards those aspects of my personality I don't like	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When something painful happens I try to take a balanced view of the situation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When I'm feeling down, I tend to feel like most other people are probably happier than I am	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I try to see my failings as part of the human condition	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When I'm going through a very hard time, I give myself the care and tenderness I need	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When something upsets me, I try and keep my emotions in balance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When I fail at something that's important to me, I tend to feel alone in my failure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When I'm feeling down I tend to obsess and fixate on everything that's wrong	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When I feel inadequate in some way, I try and remind myself that feelings of inadequacy are shared by most people	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I'm disapproving and judgemental about my own flaws and inadequacies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I'm intolerant and impatient towards those aspects of my personality I don't like	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Perceived Stress (Time 1, 2, 3, 4): Measured with the 10 item Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983) (item 1-10) supplemented with 6 items from the College Student Stress Scale (Feldt, 2008) (item 11-16)

	Never	Almost never	Sometimes	Fairly often	Very often
Been upset because of something that happened unexpectedly?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Felt that you were unable to control the important things in your life?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Felt nervous or/and "stressed"?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Felt confident about your ability to handle your personal problems?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Felt that things were going your way?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Found that you could not cope with all the things that you had to do?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Been able to control irritations in your life?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Felt that you were on top of things?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Felt angered because of things that were outside your control?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Felt difficulties were piling up so high that you could not overcome them?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Felt anxious or distressed about personal relationships?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Felt anxious or distressed about family matters?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Felt anxious or distressed about financial matters?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Felt anxious or distressed about academic matters?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Felt anxious or distressed about housing matters?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Felt anxious or distressed about being away from home? (if you don't live away from home, please skip item)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Body Mass Index (BMI) (Time 1, 4, 5).

Self-reported height and weight were used to calculate BMI (kg/m²).

How tall are you? (if you are not sure, please guess and do not leave blank): _____

Specify units for your self-reported height...

- ☐ Cm
- ☐ Feet/Inches

How much do you currently weigh? (if you are not sure, please guess and do not leave blank):

Specify units for your self-reported weight...

- ☐ Kgs
- ☐ Pounds

Just so that we know: how accurate are your estimates of your self-reported weight and height?

- ☐ Both pretty accurate
- ☐ Height pretty accurate, but I guessed my weight
- ☐ Weight pretty accurate, but I guessed my height
- ☐ I guessed both

Eating behaviour (Time 1 and Time 4): Fat and Fibre Screener, Block et al., 2008

Now please think about your eating habits over the past month. About how often do you eat each of the following foods? Remember breakfast, lunch, dinner, snacks and eating out. Check one box for each food.

	Once a MONTH or less	2-3 times a MONTH	1-2 times a WEEK	3-4 times a WEEK	5+ times a WEEK
Hamburgers, ground beef, meat burritos, tacos	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Beef or pork, such as steaks, roasts, ribs, or in sandwiches	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fried chicken	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hot dogs, or Polish or Italian sausage (salami)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cold cuts, lunch meats, ham (not low-fat)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bacon or breakfast sausage	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Salad dressings (not low-fat)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Margarine, butter or mayo on bread or potatoes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Margarine, butter or oil in cooking	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eggs (not just egg whites)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pizza	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cheese, cheese spread (not low-fat)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Whole milk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
French fries, fried potatoes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Corn chips, potatoes chips, popcorn, crackers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Doughnuts, pastries, cake, cookies (not low-fat)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ice-cream (no sorbet or non-fat)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Think about your eating habits over the past month. About how often do you eat each of the following foods? Remember breakfast, lunch, dinner, snacks and eating out. Check one box for each food.

	Less than once a WEEK	Once a WEEK	2-3 times a WEEK	4-6 times a WEEK	Once a DAY	2+ a DAY
Fruit juice, like orange, apple, grape, fresh, frozen or canned. (Not sodas or other drinks)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How often do you eat any fruit, fresh or canned (not counting juice)?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vegetable juice, like tomato juice, V8, carrot	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Green salad	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Potatoes, any kind, including baked, mashed or french fried	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vegetable soup, or stew with vegetables	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Any other vegetables, including string beans, peas, corn, broccoli or any other kind	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fibre cereals like Weet- Bix, Bran, Muesli	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Beans such as baked beans, pinto, kidney, or lentils (not green beans)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dark bread such as whole wheat or rye	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Physical activity (Time 1 and Time 4): International Physical Activity Questionnaire (IPAQ),
Craig et al., 2003

We are interested in finding out about the kinds of physical activities that students do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____ **days per week**

☐

No vigorous physical activities → *Skip to question 3*

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐

Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ **days per week**

☐

No moderate physical activities → *Skip to question 5*

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

☐ No walking → *Skip to question 7*

6. How much time did you usually spend **walking** on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

Alcohol use (Time 1 and Time 4):

1. Do you drink alcohol? ☐ yes
 ☐ no

Please report:

- a. How many standard drinks (see image) do you currently consumed on a *typical day* when drinking
- b. How many standard drinks (see image) do you currently consume in a *typical week*.

What's a Standard Drink?



One glass, bottle
or can of beer



One small glass
of wine



A double measure
of spirits (30mls)



A pre-mixed drink
(e.g. Cruiser, Stoli)
approx **1.5 drinks**



A jug of beer
equals **3 drinks**



A bottle of wine
equals **7.5 drinks**